CFR Final Rule

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Header Information

DEPARTMENT OF TRANSPORTATION
Federal Aviation Administration
14 CFR Part 25
[Docket No. 18887; Amendment No. 25-49]

Aircraft Tires; Airworthiness and Performance Standards

Preamble Information

Federal Aviation Administration, DOT
ACTION: Final rule
14 CFR Parts 25 and 37
Amendment Nos. 25-49 and 37-46

SUMMARY: The purpose of these amendments is to incorporate updated and improved minimum performance standards applicable to main landing gear and nose wheel aircraft tires, and more comprehensive transport category airplanes type design standards covering tire loads and speed ratings. These revisions are necessary in the interest of safety to meet increasingly severe tire operating conditions. The amendment for tire standards specifies a cutoff date after which tire manufacturers can no longer identify certain highspeed tires as approved under earlier standards.
EFFECTIVE DATE: December 31, 1979.
FOR FURTHER INFORMATION CONTACT: Mr. Raymond E. Ramakis, Regulatory Projects Branch, AVS-24, Safety Regulations Staff, Associate Administrator for Aviation Standards, Federal Aviation Administration, 800 Independence Ave., SW., Washington, D.C. 20591; telephone (202) 755-8716.
SUPPLEMENTARY INFORMATION:

BACKGROUND
During recent years, there has been a series of accidents and incidents involving large commercial jet airplanes, particularly wide-body types, that involved failures of tires, wheels, brakes, and anti-skid devices. Some of these events resulted in complete destruction of three airplanes and in injuries and fatalities to occupants.
Beginning in 1975, the FAA placed strong emphasis on intensifying its ongoing safety surveillance efforts with respect to aircraft tires and began an analysis of tire failures and potential corrective actions. The FAA determined that complex landing gear systems, unprecedented high maximum aircraft operating weights, and the operation of all aircraft

at higher taxi speeds over long taxi distances were among the significant factors in the tire failures.

As a result of its evaluation, the FAA developed tentative changes to the standards for both tires and wheel-brake assemblies. These efforts led to joint FAA-industry meetings in 1976 and 1977 during which the proposed standards were further revised and updated to reflect the latest technology and to meet operating conditions. Notice No. 78-16 (43 FR 57261; December 7, 1978) was issued to upgrade standards for aircraft wheels and wheel-brake assemblies and a final rule on that subject is published in this issue of the Federal Register. With respect to tires, on March 9, 1979, the FAA issued Notice No. 79-7 (44 FR 16430; March 19, 1979), which proposed regulatory changes directed at upgrading and improving the minimum performance standards applicable to main and nose wheel aircraft tires (Section 37.167 Aircraft Tires - TSO-C62b), and more comprehensive transport category airplane type design standards covering tire loads and speed ratings (Section 25.733). That Notice also proposed that all tires approved under the TSO procedures and manufactured after a specified future date meet the new standards.

This rulemaking action is one of a number of related steps in a program to resolve the tire problem. Though not part of this rulemaking action, the FAA has taken or has under consideration other actions intended to improve tire maintenance practices and to update requirements for tires installed on airplanes currently in service. Advisory Circular No. 20-97, High Speed Tire Maintenance and Operational Practices, dated 1/28/77, and Maintenance Bulletin 32-3, (1/28/77) provide guidance material to assist the operating personnel concerned with tire maintenance. In the regulatory area, the FAA, in this issue of the Federal Register, is proposing an operating rule that would require certain airplanes to be equipped with tires meeting the new TSO standards by specified future dates.

Interested persons have been afforded an opportunity to participate in the making of these amendments and due consideration has been given to all matter presented. The more significant comments received in response to Notice 79-7 are discussed below. A number of substantive, editorial, and clarifying changes have been made to the proposed rules based on relevant comments received and on further review within the FAA. Except for minor editorial and clarifying changes and the changes discussed below, these amendments and the reasons for their adoption are the same as those contained in Notice 79-7.

These amendments implement the President's directive (Executive Order 12044) that regulations be as simple as possible and not impose unnecessary burdens on the economy or on the regulated public. They also are designed to promote the public interest by increasing safety and the efficiency of aircraft through use of improved equipment.

DISCUSSION OF COMMENTS

Thirty-three individual sets of public comments were submitted in response to Notice 79-7. Many of the commenters submitted multiple lengthy recommendations. While the great majority of the commenters were in general agreement with the objectives of the proposals, a number of them suggested changes, requested clarification or guidance, and offered specific criticisms. Other commenters proposed changes that are beyond the scope of this rule making and they are not discussed here.

Section 25.733

Several commenters questioned the requirements in proposed Section 25.733. Under proposed Section 25.733(a), one commenter stated that the operational inflation pressure rating associated with the load rating should be provided. This is not practicable as these pressures, prescribed by the airframe manufacturer, will vary depending upon the maximum operating gross weight of the airplane. Another commenter recommended a clarification of paragraph (a)(1) to include consideration of the most critical combination of loads up to maximum ramp weight and deletion of engine thrust and inertial effects. The commenter pointed out that because of variations in the position of the airplane center of gravity, the highest tire load condition is not always at maximum ramp weight of the airplane and that engine thrust and inertial effects are minor and should be considered under the proposed 7 percent load factor. Clearly, the most critical combination of airplane center of gravity and airplane weight (up to maximum ramp weight) should be considered in the establishment of the maximum load rating of the tire. However, the engine thrust and inertia effects should not be excluded from this established rating since, while these effects are minor, the 7 percent is intended to cover other unequal load conditions. Finally, in response to two other comments, paragraphs (a)(1) and (a)(2) are clarified with respect to the application of a single tire installation. With the changes noted, Section 25.733(a) is adopted as proposed.

Under proposed Section 25.733(b), one commenter suggested that paragraphs (b)(1), (b)(2), and (b)(3) be changed to reflect the critical airplane maximum weight, up to the maximum ramp weight and landing weight, as applicable. For the reasons discussed under paragraph (a), the most critical combination of airplane center of gravity and airplane maximum weight up to maximum ramp or maximum landing weight, as applicable, should be assessed in determining the tire load rating. One commenter suggested that the ability of a nose wheel tire to sustain an increased load by a factor of 1.5 in paragraph (b)(2) and (b)(3) be demonstrated while another commenter under paragraph (b)(3) recommended terminology change from "wheel" to "wheel-tires". However, service experience does not warrant imposing the burden of demonstrating the designed 1.5 nose wheel load factor and no justification was given for changing "wheels" to "wheel-tires". Section 25.733(b) is adopted as proposed with the changes noted.

Under proposed Section 25.733(c), one commenter pointed out that paragraphs (c)(1) and (c)(2) would be meaningless unless a statement concerning an increase in tire inflation pressure (due to the 1.07 factor) was included. Since the proposed 7 percent load factor in paragraph (c)(1) can only be maintained with a corresponding increase in inflation pressure, a provision for required inflation pressure necessary to assure the application of this derating factor is therefore included in the proposed operating rule published in this issue of the Federal Register. Although another commenter suggested clarifying the term "axle" with respect to additional configurations, the description of the landing gear axle is sufficiently clear to accommodate all multiple main wheel tire configurations. Two commenters stated that paragraph (c)(2) should include a reference to paragraph (b)(3) for nose wheel tires. One of the commenters also suggested that the word "tire" be added and that the paragraph include the 1.07 factor. In addition, one commenter questioned the absence of the 1.5 factor as proposed in paragraph (b). For clarity, paragraph (c)(2) should contain the paragraph reference (b)(3) and the additional word "tire" at the end of the paragraph. However, service experience does not warrant application of the 7 percent

load factor to nose wheel tires. The 1.5 factor is not appropriate to main wheel tires since it is applied only to the nose wheel tire on the basis of additional takeoff and landing loads. Proposed Section 25.733(c), (c)(1), and (c)(2) are adopted with the changes noted. Recommended changes to proposed Section 25.733(d) included a provision for allowing intentional tire contact from items such as rub strips, spin brakes, and guide rails. Another recommendation concerned the need to specify tire clearance on the basis of dynamic growth conditions. Paragraph (d) is revised to provide for intentionally designed contact as suggested. However, any other contact, considering both static and dynamic conditions, would not be allowed under this paragraph. One commenter stated that paragraph (d) should also apply to nonretractable landing gear systems. However, because of the different factors involved, the FAA will consider whether requirements for nonretractable gear may be necessary in future rulemaking actions.

Finally, a new paragraph was recommended by one commenter to provide that failure of any one tire on multiple wheel aircraft during takeoff, rejected takeoff, or landing should not cause hazardous loss of braking or directional control of the airplane. The objective of Section 25.733, as well as that of Section 25.735, is to preclude the hazardous loss of braking and airplane directional control due to system failure. The upgraded standard here being adopted is directed at reducing single and multiple tire failures. Since the revision will accomplish this objective, the recommended change is not necessary.

Section 37.167 Aircraft Tires - TSO-C62c

No substantive comments were received on the applicability provisions in Section 37.167(a) and it is adopted as proposed.

With respect to the marking requirement under proposed Section 37.167(b), one commenter recommended in paragraph (b)(1) that the "brand name" be deleted as the manufacturer's name was considered sufficient. Another commenter recommended that, to be useful, the qualification test date or date of manufacture should be included. The deletion of brand name in lieu of manufacturer name is not appropriate, since a manufacturer may produce multiple brands. The need for dates is not justified since a qualification test date is already contained under approval records, and the date of manufacture can be readily obtained from the tire serial number. Under paragraph (b)(2), a commenter suggested adding the phrase "over 120 mph" after speed rating and adding "ply rating" in lieu of "load rating" since it is recognized by all standardization bodies. The same commenter suggested the deletion of "skid depth" and "manufacturer part number" as not being necessary. The load rating should not be eliminated since, like the speed rating, it identifies the maximum operating load condition the tire should not exceed. The speed rating marking for a tire operating at 120 mph and below should not be deleted for the same reason. Contrary to the commenter's assertion, the skid depth and manufacturer's part number are required because they identify a given design and the characteristics of a given design which may affect tire performance. There is nothing to preclude a ply rating marking on a tire if desired by the tire manufacturer. Section 37.167(b) is adopted as proposed.

Proposed Section 37.167(c) sets forth data requirements. One commenter recommended that the word "mold" be added before "skid depth" in proposed Section 37.167(c)(1) because the mold skid-depth can be controlled. The requirement has been changed accordingly. Under the same paragraph one commenter suggested the addition of nominal

and actual load radius, including tolerances, at rated load and inflation pressure. Another commenter suggested the submission of load-deflection curves or test results. To ensure completeness of data, it is appropriate to add nominal and actual tire loaded radii including tolerances at rated load and inflation pressure. The submission of load deflection information is necessary to assure compatibility between tires installed on an aircraft. Proposed Section 37.167(c)(1) is revised accordingly.

Section 37.167(c)(2) would require the tire manufacturer to furnish applicable maintenance and repair instructions. One commenter suggested that the tire manufacturer consult with the aircraft manufacturer to ensure necessary input to the instructions. Three other commenters objected outright to the proposal. One stated that this would imply mandatory use of that information by an operator or retread agency, both of whom are certified by the FAA. Another suggested that recapping or retreading procedures should be in a separate document and not mixed in with new tire requirements. The third commenter suggested the deletion of the entire paragraph on the ground that retreading of aircraft tires is not a repair. According to the last commenter, the fact that retreaders use different materials, different numbers of reinforcing plies, different shaped molds, different tread patterns, different skid depth, etc., results in a product (retread) that is not a repaired new tire but a new product, one ingredient of which is a used carcass. On this basis it was suggested that a Technical Standard Order (TSO) governing the performance standards required for a retread should be issued. According to the commenter, this could be very similar to the new tire TSO and require virtually all of the certification required of a new tire. Requiring a manufacturer to supply the information outlined in Section 37.167(c)(2) is consistent with other regulations, such as Sections 23.1529, 25.1529, 27.1529 and 33.5, that require manufacturers to supply maintenance and inspection information with their products. The reason the criteria were outlined in the proposal was to identify specific maintenance and inspection information that a manufacturer must provide with its product. This information is intended to be made available to persons who maintain tires. It is not considered necessary that such information be the result of consultation with the airframe manufacturer. There are widely varying types of operations in the airlines and wide variation in airlines' capability to develop tire maintenance and inspection data. Not all users and repair facilities have this capability and of necessity must rely on data developed by the manufacturer as a basis to maintain and inspect tires. To require a new tire to be built under one TSO and then maintained under a separate TSO is impractical. Under the maintenance performance rules of Section 43.13(a) and (b), a product after undergoing maintenance shall be at least equal to its original or properly altered condition. This makes it necessary for a tire on which maintenance was performed to continue to meet the requirements outlined in the TSO under which it was built. However, if a tire undergoing repair were altered, it would be considered a new product and it would be necessary for the tire to be tested for approval under the TSO and be approved for use on each aircraft of which it would be a part. Section 37.167(c)(2) is therefore adopted as proposed.

Section 37.167(d) proposed a two-year cutoff date after which all newly manufactured tires could no longer be identified as approved under earlier tire standards. One set of commenters recommended the exclusion of low-speed tires on the basis testing and related costs are not supported by adverse service experience. They contended that low-speed tires should be requalified only when the new ratings differ from those ratings on

tires previously approved. Another group commenting on high speed tires recommended that the 2-year cutoff date be deleted, stating that the new TSO requirements should be applied to existing aircraft only on a case-by-case basis as supported by tire service history data. They further indicated that installing new and heavier tires on existing aircraft would require further analysis and flight tests to assure that the aircraft and systems would not be adversely affected. Several commenters of this group recommended extending the cutoff date to periods up to 5 years because of the limited dynamometer capacity available, costs, and possible tire shortages. One of the commenters pointed out that tires which the FAA wants to have qualified in a shorter time could be accomplished through the issuance of a proposed operating rule. Finally, two commenters questioned the application of the proposal to all tires when the preamble noted implementation of an operating rule affecting only certain aircraft.

Information contained in the many comments received in response to Section 37.167(d) indicates that the proposed 2-year cutoff date for manufacturing of all tires to the old standards is too restrictive. Specifically, it would have a significant and adverse impact on the manufacture of low-speed tires which do not share the same failure history as reported on high-speed tires. Based upon a review of service experience, which for low-speed tires has been good, and after further consideration, the FAA has determined that low-speed tires need not be requalified and should be excluded from the proposed cutoff requirements. This exclusion applies to all presently approved tires rated at speeds up to 160 mph.

In this issue of the Federal Register the FAA is proposing an operational requirement for retrofit installation by certain rates of new high-speed tires (above 160 mph) on certain transport category airplanes whose tire problems and hazards are more clearly identified. That action, however, does not preclude the need to phase out the manufacture of tires approved under older standards for use on other aircraft operating at high gross weights or speeds or both. With respect to high-speed tires (rated over 160 mph), several commenters recommended extending the proposed 2-year cutoff date for manufacture under older standards. In their view, the 2-year date is too early and they specifically recommended that 3 years would be more realistic. The commenters pointed out that the cutoff must be consistent with availability of tires meeting the new standard. The controlling factors for this availability are the limited number of dynamometers industry-wide that can be used to test each tire model and the time required to redesign, retest, and then manufacture the large number of tire models involved. These and related factors, which are discussed in detail in the preamble of the notice published in this issue of the Federal Register, are used in arriving at dates by which certain transport category airplanes can be retrofitted with tires meeting the new standard. Based on the comments and data submitted, and upon reconsideration of the matter, the FAA has determined that discontinuance of manufacture of older high-speed tires by a date 3 years after the effective date of the new TSO standard is consistent with the development and manufacture of tires to the new standard to provide the necessary improvement in safety. This cutoff date will impose no undue economic burden in tire manufacturers or operators since it will provide adequate time for development of newly designed tires yet permit manufacture of older design tires to the extent necessary to assure an adequate supply pending completion of retrofit.

STANDARD FOR AIRCRAFT TIRES

Section 1.0 Purpose.

Two commenters recommended that the proposed new standard be limited to tires for transport category airplanes and that Part 27 and Part 29 rotorcraft tires be excluded. One of the commenters contended that the proposed changes result from service experience on wide-bodied jet airplanes, and that they were unaware of comparable service experience on rotorcraft of any size or category. Another commenter stated similar reasons for excluding tires for Part 23 aircraft and suggested the establishment of two standards. The standards should not be limited to large aircraft since the requirements in the standard take into account the variation in tire performance as characterized by small and large aircraft. Moreover, as previously discussed, low-speed tires approved to older standards may continue to be manufactured under the terms of their original approval. Paragraph 1.0 is adopted as proposed.

Section 2.0 Scope.

One commenter recommended the inclusion of "inflation pressure" in connection with the load rating. While a rated inflation pressure must be established to provide for the design load rating of the tire, such information will be obtained by the FAA under the proposed data requirements in Section 37.167(c). Therefore, there is no basis for including inflation pressure also under paragraph 2.0. Paragraph 2.0 is adopted as proposed.

Section 3.0 Material requirement.

One commenter recommended that the requirement also address processes which could equally affect performance. Another commenter pointed out the difference of materials between small and large aircraft tires and suggested that the suitability of materials should be predicated upon a substantiated service experience involving a tire of similar size and speed rating. The requirement is directed to the suitability of materials and the comments do not justify expanding the requirement to cover processes or explain why service experience should be limited in the narrow way suggested. Paragraph 3.0 is adopted as proposed.

Section 4.0 Design and construction.

No comments were received on individual requirements relating to unbalance, balance marker, and overpressure, paragraph 4.1, 4.2, and 4.3, and they are adopted as proposed. In proposed paragraph 4.4.1 of the standard relating to ambient temperature, several commenters objected to the optional use of analysis since it was claimed no analysis method is known. Another commenter recommended that the paragraph be deleted or changed to read: "* * * shown by analysis that the physical properties of the tire materials have not been degraded by exposure of the tire to * * *" That commenter pointed out that the recommended change would allow tire sample tests in lieu of requiring the use of facilities for full-scale tests which are not available. Another commenter questioned the severity of the proposed test temperatures and duration and questioned whether it would prohibit operations on aircraft cleared at lesser temperatures. In response to these comments, an optional analysis method should be allowed since an analysis method may exist or might be developed. The proposed tests need not nor were they intended to

involve the performance of a full-scale tire. Therefore, the recommended change for applicable tests or analysis to substantiate the physical properties of the tire materials is adopted. Based on service experience, the 24-hour test period is not overly severe and the actual operational tire temperatures are consistent with those prescribed. Finally, although questioned by one commenter, the temperature limits specified are clearly stated.

In proposed paragraph 4.4.2 of the standard, concerning wheel rim heat, one commenter questioned the basis for the prescribed temperature and duration, while two other commenters objected to the application of the 300° F wheel bead seat temperature to nose wheel tires and low-speed tires. They suggested that paragraph 4.4.2 apply only to high-speed tires or that, in the case of nose wheel tires, they be identified for non-use on wheels subjected to operational temperatures in excess of 250° F. Not all aircraft tires operate within the proposed temperature environment and exposure period. To accommodate different tire designs which, by application are not to be operated near the prescribed 300° F temperature, paragraph 4.4.2 is revised to allow low-speed tires or nose wheel tires to be tested or analyzed at other highest wheel bead seat temperatures expected to be encountered during normal operations. Although questioned by one commenter, the provisions for an optional analysis method is retained for the reasons previously discussed in connection with ambient temperature. For consistency with paragraph 4.4.1 the requirement has been reworded to require that the physical properties of the tire materials not be degraded by exposure to the specified conditions.

Two commenters suggested wording changes to paragraph 4.5 concerning tread design, but these were not substantively justified or indicated as necessary for clarity. The paragraph is adopted as proposed.

Under paragraph 4.6, Slippage, one commenter questioned the basis for not allowing slippage within the first five cycles. The prescribed five dynamometer cycles have been an accepted industry practice to assure that the tire is properly fitted to the wheel during and prior to the initiation of tests. Experience obtained from past testing indicates that a period of five landing cycles is satisfactory. Paragraph 4.6 is adopted as proposed.

Considering it to be a necessary requirement, one commenter recommended addition of a new paragraph 4.7 covering an air leakage test. The recommended leakage test is an essential performance requirement and, since it is consistent with the current industry practice and will not result in any undue burden, the recommendation is adopted as new paragraph 4.7.

Section 5.0 Ratings.

Under paragraph 5.1, load ratings, two commenters recommended a change to provide that tires of proper load ratings be selected in accordance with the applicable FAR, but that the ratings for selection be established by a recognized industry standardization body or by the Administrator. The applicant should have the right to select or establish a tire load rating as long as it is in compliance with the applicable FAR sections. As provided under Section 25.733, the Administrator approves the load rating once established. The recommendations which would provide that some third-party organization establish the tire load rating is, therefore, not accepted.

One commenter recommended that the manufacturer be required to make tire deflection information available to assure compatibility of tires on the same axle while two other commenters recommended that the deflection provision be deleted since it is not part of

the load rating or required under the TSO. To eliminate the confusion between "tire deflection" and "percent deflection" one of the commenters recommended the addition of a new paragraph and term "loaded radius" which is defined as the distance between the axle centerline and the operating surface of a loaded tire. The commenter also recommended that the tire load rating be established by the tire manufacturer and approved by the Administrator. Another commenter suggested changing the second sentence to identify tire deflection at loads up to 1.5 times the rated load and rated inflation pressure.

Under the standard a tire need not be designed to any specific load-deflection criterion. However, it is necessary that a tire's deflection characteristics at various loads and inflation pressures be identified to assure that a given tire design is compatible with another tire during its installation on an aircraft. In this issue of the Federal Register, the FAA is proposing as part of a new operating rule that the deflection between two tires mounted on a single axle be within acceptable limits at various operational loads up to maximum rated loads. The identified deflection information, which will form the basis for this acceptance, is required under Section 37.167(c). Deflection at higher loads up to 1.5 times rated load must be included under this information. The description of tire deflection in terms of "percent deflection" can be deleted in view of a more appropriate "loaded radius" definition. Since, as provided under Section 37.167(c), the manufacturer or TSO applicant must furnish the tire load rating, there is no basis for also referencing the tire manufacturer under paragraph 5.1. Therefore, the identification of a more appropriate loaded radius criterion is provided under a new paragraph 5.3 and Section 37.167(c). Paragraph 5.1 is revised accordingly by deleting the sentences pertaining to percent of deflections and radial distance.

Under paragraph 5.2, Rated inflation pressure, one commenter suggested a change to specify that the inflation pressure would be established by the tire manufacturer and approved by the Administrator. However, in view of the data requirements of Section 37.167(c), there appears no need to further reference the manufacturer in paragraph 5.2. Two commenters recommended changing the ambient temperature to 68° F or to the extreme limits specified in paragraph 4.4.1 and identifying the rated inflation pressure under no load. The view to define the rated inflation pressure under either a rated load or no load was also shared by another commenter. In connection with these comments, a specific ambient or extreme temperature should not be specified since design temperatures differ among manufacturers. The recommendation to establish rated inflation pressure at extreme operating temperatures was unsupported. However, there is merit in the suggestion that the temperature on which a manufacturer bases a tire load and pressure rating should be identified. This is necessary to clarify the rated inflation pressure which, in accordance with long standing operating practice, is based upon a no load condition. Paragraph 5.2 is revised accordingly.

Section 6.0 Dynamometer test requirements.

One commenter suggested that since tire deterioration is not necessarily visible, the paragraph should state "* * * without significant deterioration of the carcass, tread, or inflation pressure * * *" A commenter also recommended that lack of such deterioration be verified by test. Another commenter recommended that since tread damage is permitted in the overload test, the paragraph should be changed to read "* * * other than

normal expected wear except as noted in paragraph 6.3.3.3." Inclusion of the word "significant" would not result in a more specific requirement. Neither has sufficient justification been shown to require further test verification in view of the new acceptance criteria established under paragraph 6.3.3.3 for the single tire test specimen at the end of the overload test. However, as recommended, there is no basis to exclude tread damage which is permitted in the overload test. Paragraph 6.0 is revised accordingly.

One commenter suggested that paragraph 6.1.1 relating to tire test load be clarified by specifying "test surface" rather that "flywheel". However, the requirement proposed appears clear. In paragraph 6.1.2, one commenter recommended clarification with respect to inflation pressure. The commenter pointed out that rated inflation pressure applies to an unloaded tire and that the actual pressure under rated load will be higher for both the flat surface and the flywheel. Another commenter recommended that the percentage deflection at rated load should be the basis for determining the minimum loaded radius of the tire against the dynamometer. It was also recommended that the ambient temperature be identified. There is merit to the recommended clarification of paragraph 6.1.2 since the change would eliminate misinterpretation of test pressure as related to the rated inflation pressure identified under paragraph 5.3. Moreover, for the reasons previously discussed in connection with load ratings, there is reasonable basis for determining the minimum loaded radius and the identification of ambient temperatures as well as adopting the recommendation that the ambient temperature be identified by the manufacturer.

To provide a more realistic assessment of tire capability, two commenters recommended in connection with paragraph 6.1.3 that the high-speed dynamometer tests, including the overload takeoff test, be conducted on one tire test specimen. The proposed option for allowing a new tire to be tested to the overload test requirements of paragraph 6.3.3.3 was based on the need to perform destructive inspection on the original test specimen which had been subject to previous taxi and takeoff test cycles in accordance with paragraph 6.3.3.2 and 6.3.3.4. While destructive type inspection allows for a positive assessment of internal deterioration of the tire, such an inspection procedure can be performed after the tire has been subjected to all the dynamometer tests including the overload test. The use of one test specimen throughout the total test series represents realistic condition which assures the overload capability after having been previously subjected to operational takeoff and taxi cycles. Paragraph 6.1.3 has been revised accordingly.

In paragraph 6.2.1 concerning test temperatures for low-speed tires, several commenters recommended the deletion of "* * * at any point on the tire * * *." in the second sentence. One commenter stated that it is not necessary to determine the starting temperature at every point on the tire for the stated 90 percent of test cycles, and that the starting temperature for the remaining 10 percent of the cycles is unimportant. Two other commenters suggested that the "hottest point" be identified and used since this point controls its recycle time during the test and more nearly equates to the contained air temperature. There is merit to the suggestion that the test temperature be measured at the hottest point and the requirement has been changed accordingly. However, there is no basis for deleting the temperature requirement for 10 percent of the test cycles since the prescribed conditions provide for test uniformity with respect to an acceptable minimum starting temperature. Finally, one commenter questioned the proposed temperature and recommended that a more realistic starting temperature should be obtained from known operational data and that it should be measured on the basis of contained air at the bottom

of the tire. In this connection, a need exists to base temperatures on defined operating conditions. However, precise operational information is not readily available at this time, and the temperatures prescribed are intended to set safe limits. Research and development programs are presently being undertaken to obtain useful realistic operating temperature data which can be correlated with laboratory tests.

Paragraph 6.2.2 of the standard states kinetic energy requirements. One commenter recommended that the FAA re-examine the need for retaining the deceleration (energy absorption) type dynamometer requirements, since dynamometers are presently available to test all tires to the takeoff profile specification. However, it does not appear advisable to eliminate the use of the energy absorption type dynamometer since information from manufacturers indicates that takeoff type equipment is not available for testing low-speed tires. As discussed under paragraph 6.3, the limited takeoff dynamometer facilities must be used for high-speed tire tests. Another commenter indicated that the energy conversion constant was in error and should be 0.011 as currently required. As discussed in the preamble of Notice 79-7, the proposed energy constant .011 (derived in terms of mph) was changed to .0113 to accommodate its use with an equivalent factor .015 (derived in terms of knots) established under the military tire specification MIL-T-5041G. This change will allow the testing of both civil and military tires to the same kinetic energy value. Both of the constants, .011 and .015, were derived on the basis of general assumptions relative to the absorption of kinetic energy by the brake and tire. The change to the more correct value is relatively small and will not be significant to manufacturers, particularly since tires (speed rating of 160 mph or less) may continue to be manufactured under previous approvals as discussed under Section 37.167(d). Paragraph 6.2.2 is adopted as proposed.

In paragraph 6.2.4 of the standard three commenters pointed out an error which existed in the formula for computing kinetic energy absorption time. Paragraph 6.2.4 is revised to correct this error.

One commenter on paragraph 6.3 of the standard applicable to high-speed tires recommended a rewording to more accurately define the high-speed test condition and to require the airframe manufacturer to define and supply the takeoff details. The paragraph is revised to clarify and further define the high-speed test condition. However, the recommendation that the included test curves must be supplied by the airframe manufacturer is not accepted. Tire manufacturers may produce and qualify tires to any set of load-speed-time data they choose. The use of these tires is adequately regulated by the provisions of FAR Part 25, which appears to meet the commenter's concern.

For the high-speed tire test temperature requirements of paragraph 6.3.1, two commenters recommended that the specified temperature be that of the hottest point of the carcass but not less than 120° F for the taxi test and not less than 105° F (as stated in paragraph 6.2.1) for all other tests. The recommendation was based on the higher tread temperature experienced in the laboratory as compared to in-service conditions. It was pointed out that the higher recycle temperature (120° F) may result in a tire design detrimental to economic field operation with no increase in safety and that 105° is used as the starting takeoff temperature under Department of Defense Specification MIL-T-5041G. Another commenter indicated that the 120° F starting temperature may not be representative and that a time between cycles should be established relating to actual operating conditions. Two commenters recommended that the 120° F apply to the tire air or carcass

temperature at the start of 90 percent of the test cycles except for the overload test which should begin at 105° F. The FAA agrees that the measurement of tire temperature should be made at the hottest point. However, the 105° F starting temperature for takeoff cycles and alternate test permits achieving a peak test temperature consistent with actual peak temperatures seen in service. Since a higher test temperature would not provide any clear benefit and could unnecessarily restrict design freedom, the 105° F starting temperature is adopted. For the remaining 10 percent of the cycles of each group, the starting temperature is specified as 80° F to provide a temperature consistent with the temperature gradient provided in paragraph 6.2.1.

In paragraph 6.3.2 of the standard, two commenters recommended a minimum reserve factor or 5 mph margin for each speed rating. However, current service experience does not support the need for such margins and no justification was provided by the commenters. The paragraph with its included table of values is adopted as proposed.

Paragraph 6.3.3 of the TSO standard specifies dynamometer cycles. One commenter suggested that the requirement be more realistic. A further comment recommended that the number of test cycles be representative of the number of flights an average tire lasts before its first retread and that the tests include landing cycles and yaw conditions. Another commenter suggested that the requirement be clarified with respect to the number of tires tested. It was also suggested that the dynamometer cycle include side-load conditions. However, the increase in the number of cycles as originally proposed is sufficient to provide for a satisfactory assessment of the minimum performance of a tire considering both tread retention and overall carcass strength. With respect to the recommended side-load test, it is recognized that the lateral loading of tires during maneuvers such as turning does result in overload conditions which have a definite effect on tire life and performance. However, the prescribed overload tests under paragraph 6.3.3.3 and taxi tests under 6.3.3.4 provide for such conditions. Paragraph 6.3.3 is adopted as proposed.

In paragraph 6.3.3.1 covering symbol definitions, one commenter recommended that to be consistent with Figures 1 and 2, the symbol "L_2" should be redefined as the rated load. Two other commenters suggested that "L_2" be redefined as zero tire load or a load equal to 1.07 times the tire load at the maximum ramp weight. Another commenter recommended that the symbol "L_0" be defined as the tire load at the start of test cycle. To provide a correct definition of symbols appropriate to Figures 1 and 2, the symbol "L_2" is applied to a zero tire load and the symbol "L_0" is applied to the tire load at the start of the cycle but not less than the rated load. The test loads required under this paragraph will, by definition, verify the rated load and, as applicable to main wheels under Section 25.733(c)(1), take into account the 1.07 factor.

In response to a comment, paragraph 6.3.3.2 is amplified to indicate specifically the proper application of Figures 1 and 2 to takeoff cycles.

For the overload takeoff cycle of paragraph 6.3.3.3, one commenter recommended that a used tire (equal to half wear) be subjected to the test. In a similar vein, another commenter indicated it was unrealistic for a new tire to be used for the test when the object of the TSO is to clear the tire design for the first tread life. The comments are valid to the extent they recommend that some form of used tire, rather than a new tire meet the test. However, it is not necessary to specify a used tire. A tire that has been subjected to previous taxi and takeoff tests represents a realistic condition for assessing overload

capability. The reason for this is to assure that the tire design has an overload capacity taking into account the tire service life. One commenter pointed out that maintaining the tire rated inflation pressure is an ambiguous statement and suggested that at the completion of test and when the temperature is stabilized the tire should not lose pressure at a rate greater than 10 percent per hour. It was also suggested the paragraph include a statement that good condition of tread is not required. Two other commenters recommended that the tire should maintain its pressure integrity at the completion of test. The tire need not retain rated pressure at the end of test but should not lose more than 10 percent pressure within a 24-hour period. A 24-hour pressure retention period provides a more representative measure of acceptability. To assure the pressure integrity of the tire at the completion of test, paragraph 6.3.3.3 is revised to state that requirement.

In paragraph 6.3.3.4 relating to taxi cycles, one commenter recommended that the taxi test be followed immediately by the takeoff test to represent a more realistic operating condition. Another commenter suggested that the time between taxi cycles be established at more realistic conditions. While such "spectrum-type" taxi-takeoff tests represent one approach in assessing tire performance, there is insufficient information to indicate such tests approach realistic conditions or that they provide any improvement in ability to assess tire performance. The procedures set forth under this revised standard represent an upgrading of testing which is as stringent as can be achieved within the present state of the art. The FAA will continue to monitor developments in this field and the record of new tire performance, and may elect at some future time to further strengthen test requirements if it should be necessary to provide a higher level of performance with respect to improved tread retention and carcass strength. Paragraph 6.3.3.4 is adopted as proposed.

Under the alternate dynamometer tests proposed in paragraph 6.3.3.5, two commenters indicated that the equation in paragraph 6.3.3.5.2 represents a severe energy condition which is not supported by service experience. It was recommended that the tire be tested to the 160 mph speed but at the existing kinetic energy defined under paragraph 6.2.2. Two commenters also suggested that the paragraph be rewritten to provide that landing simulation tests be permitted only for tires with speed ratings of 160 mph or less. This need for limiting the alternate tests to 160 mph was pointed out by another commenter who indicated that some high-speed tires (for use above 160 mph) existed which had carcass failures after they were qualified to the reverse takeoff (energy absorption) type test. The commenter questioned the availability of the load-speed-time data and recommended that it be made available by the manufacturers. One commenter pointed out that the 160 mph landing speed does not account for higher speed conditions that are associated with large turbojet aircraft. Finally, other commenters objected to the proposed change in testing tires up to 160 mph indicating that it would have an adverse economic impact on them and that the high cost of installing a new dynamometer to meet the 160 mph test requirement would have a resultant inflationary cost and not yield any additional benefit to the consumer.

Paragraph 6.3.3.5 provides an alternate and equivalent test for tires in the 120-160 mph range when the load-speed-time data needed for the takeoff type test (paragraph 6.3.1) has not been established. The energy level proposed for the alternate dynamometer test may be too conservative in view of current service experience which indicates that tires tested to existing energy levels perform satisfactorily. Since most new tire designs will be

supported by load-speed-time data, the alternate test will retain the existing energy levels while requiring that the tire be tested at its maximum speed rating (160 mph) to demonstrate its high speed integrity. As provided in paragraph 6.3, all tires with speeds above 160 mph will be tested on the takeoff type dynamometer equipment. It should be noted that the costs of these tests to low-speed tire manufacturers are minimal since most low-speed tires are operated below the 120 mph limit even though they are rated at 160 mph under the existing standards. Therefore, the testing requirement is unchanged from the existing standard. In this connection, the requalification of tires with a speed range of 160 mph and below will not be required under Section 37.167(d). Moreover, the current definition of low-speed tire (160 mph or less) has been changed to 120 mph or less, which will benefit the low-speed tire manufacturers with limited equipment capability and help assure that tires are tested at speeds and associated energy values which are experienced in service. The requirements are restated under a new paragraph to clarify the optional application to tires with ground speeds of 160 mph or less. Paragraph 6.3.3.5 as revised is redesignated and adopted as paragraph 6.3.4.

Section 7.0 Requalification tests.
Two commenters recommended that the word "carcass" be deleted from the listing of characteristics since the carcass of the lower ply rating tire need not be identical to that of the same size tire with a higher ply rating. The recommendation is adopted. One commenter suggested that high-speed tires be exempted from the paragraph unless there is specified percent by which the load and speed should be lower. However, the FAA is not aware of service experience to indicate that a high speed tire with a lesser ply rating should be exempted. Finally, a commenter recommended that requalification of a low-speed tire to the new standards not be required if the speed, load, and inflation pressure ratings are the same as on a tire previously approved under the existing standard. As previously discussed in connection with revised paragraph Section 37.167(d), such a provision is now effective for low-speed tires previously approved.
In the proposed Figure 1, one commenter suggested simulating the combined effects of the tire rolling loads together with the rolling distance required by a rejected takeoff at that speed. The same commenter recommended that the test load curve be above the aircraft load-speed-time curve by at least 7 percent. However, as previously discussed, the combined taxi-takeoff-landing test cycle represents one approach in assessing tire performance. The test procedures are considered to be at the present state-of-the-art and will provide a higher level of performance with respect to improved tread retention and carcass strength. It should be noted that the 1.07 factor applies solely to the load rating defined and established under Section 25.733, and thus the added 7 percent must be included under the test load and appropriate load-speed-time curve as requested by the commenter. Another commenter recommended that Figure 2 be renumbered to Figure 1 with title changed to "Graphic Representation of a Universal Load-Speed-Time Cycle" to show the preferred method first. In addition, the commenter stated that in Figures 1 and 2, "L_0" should be "L_2", that "RD" should apply to "T_2", and that "$T_2 - T_1 = 3$ seconds." The proposed figures are revised accordingly.

Regulatory Information
Adoption of the Amendment

Accordingly Parts 25 and 37 of the Federal Aviation Regulations (14 CFR Parts 25 and 37), are amended as follows, effective December 31, 1979.

PART 25 -- AIRWORTHINESS STANDARDS TRANSPORT CATEGORY AIRPLANES

1. By revising Section 25.733 to read as follows:

Section 25.733 Tires

(a) When a landing gear axle is fitted with a single wheel and tire assembly, the wheel must be fitted with a suitable tire of proper fit with a speed rating approved by the Administrator that is not exceeded under critical conditions and with a load rating approved by the Administrator that is not exceeded under--

(1) The loads on the main wheel tire, corresponding to the most critical combination of airplane weight (up to maximum ramp weight), center of gravity position, and the effect of engine thrust reacted by inertia at the airplane center of gravity; and

(2) The loads corresponding to the ground reactions in paragraph (b) of this section, on the nose wheel tire, except as provided in paragraphs (b)(2) and (b)(3) of this section.

(b) The applicable ground reactions for nose wheel tires are as follows:

(1) The static ground reaction for the tire corresponding to the most critical combination of airplane weight (up to maximum ramp weight) and center of gravity position with a force of 1.0g acting downward at the center of gravity. This load may not exceed the load rating of the tire.

(2) The ground reaction of the tire corresponding to the most critical combination of airplane weight (up to maximum landing weight) and center of gravity position combined with forces of 1.0g downward and 0.32g forward acting at the center of gravity. The reactions to this case must be distributed to the nose and main wheels by the principles of statics with a drag reaction equal to 0.32 times the vertical load at each wheel with brakes capable of producing this ground reaction. This nose tire load may not exceed 1.5 times the lead rating of the tire.

(3) The ground reaction of the tire corresponding to the most critical combination of airplane weight (up to maximum ramp weight) and center of gravity position combined with forces of 1.0g downward and 0.20g forward acting at the center of gravity. The reactions in this case must be distributed to the nose and main wheels by the principles of statics with a drag reaction equal to 0.20 times the vertical load at each wheel with brakes capable of producing this ground reaction. This nose tire load may not exceed 1.5 times the load rating of the tire.

(c) When a landing gear axle is fitted with more than one wheel and tire assembly, such as dual or dual-tandem, each wheel must be fitted with a suitable tire of proper fit with a speed rating approved by the Administrator that is not exceeded under critical conditions, and with a load rating approved by the Administrator that is not exceeded by--

(1) 1.07 times the loads specified in paragraph (a)(1) of this section on each main wheel tire; and

(2) Loads specified in paragraphs (a)(2), (b)(1), (b)(2), and (b)(3) of this section on each nose wheel tire.

(d) Each tire installed on a retractable landing gear system must, at the maximum size of the tire type expected in service, have a clearance to surrounding structure and systems that is adequate to prevent unintended contact between the tire and any part of the

structure or systems.

PART 37 -- TECHNICAL STANDARD ORDER AUTHORIZATIONS
2. By revising Section 37.167 to read as follows:

Section 37167 Aircraft Tires -- TSO-C62c
(a) Applicability. This technical standard order (TSO) prescribes the minimum performance standards that tires, excluding tailwheel tires, must meet in order to be identified with the applicable TSO marking. Tires which are to be so identified and which are manufactured on or after December 31, 1979, must meet the requirements of the "Federal Aviation Administration Standard for Aircraft Tires," effective December 31, 1979, set forth at the end of this section.
b) Marking. In lieu of the marking requirements of Section 37.7(d), aircraft tires must be legibly and permanently marked at least with the following:
(1) Brand name and the name or registered trademark of the manufacturer responsible for compliance.
(2) Speed rating, load rating, size, skid depth, serial number, and the manufacturer's part number and plant code.
(3) Applicable technical standard order (TSO) number.
(c) Data requirements. (1) In addition to the data specified in Section 37.5, the manufacturer must also furnish to the Chief, Engineering and Manufacturing Branch, Federal Aviation Administration (or, in the case of the Western Region, the Chief, Aircraft Engineering Division), in the region in which the manufacturer is located, one copy, or copies as otherwise requested by the regional office, of the following technical data: speed rating, load rating, rated inflation pressure, tire size, width, outside diameter, mold skid depth, nominal loaded radius at rated load inflation pressure, permissible tolerance on the nominal loaded radius, the actual loaded radius of the test tire at rated load and inflation pressure, weight, static unbalance of the test tire, wheel rim designation, manufacturer's part number and, for high-speed tires, a load deflection curve at loads up to 1.5 times load rating, and a summary of the load-speed-time parameters used in the dynamometer tests. As used in this section, the term "high-speed tire" means a tire tested at a speed greater than 120 mph.
(2) The manufacturer must also furnish the applicable maintenance and repair instructions to the regional office identified in paragraph (c)(1) of this section. The maintenance data provided by the manufacturer must include inspection criteria for tires to determine eligibility for used tires to be continued in service. Recapping procedures must be included in the maintenance information along with any special repair methods applicable to the tire and special nondestructive inspection techniques.
(d) Previously approved equipment. (1) Notwithstanding Section 37.3(a) and (b) of this part and the provisions of any specific previous TSO approval, after December 31, 1982, no person may identify or mark a tire having a speed rating above 100 mph with TSO numbers TSO-C62, TSO-C62a, or TSO-C62b.
(2) Aircraft tires, except for those specified in paragraph (d)(1) of this section, approved prior to December 31,1979, may continue to be manufactured under the provisions of their original approval.

Federal Aviation Administration Standard for Aircraft Tires

1.0 Purpose. This document contains minimum performance standards for new aircraft tires, excluding tailwheel tires, that are to be identified as meeting the standards of TSO-C62c

2.0 Scope. These minimum performance standards apply to aircraft tires having speed and load ratings that are established on the basis of the speed and loads to which the tires have been tested.

3.0 Material requirement. Materials must be suitable for the purpose intended. The suitability of the materials must be determined on the basis of satisfactory service experience or substantiating dynamometer tests.

4.0 Design and construction.

4.1 Unbalance. The moment (M) of static unbalance in inch ounces may not be greater than the value determined using the formula, moment (M) = $0.025D^2$ rounded off to the next lower whole number, D = maximum outside diameter of the tire in inches.

4.2 Balance marker. A balance marker, consisting of a red dot, must be affixed on the sidewall of the tire immediately above the bead to indicate the lightweight point of the tire. The dot must remain for any period of storage plus the original tread life of the tire.

4.3. Overpressure. The tire must withstand for at least 3 seconds a pressure of at least 4.0 times the rated inflation pressure (as specified in paragraph 5.2) at ambient temperature.

4.4 Temperature.

4.4.1 Ambient. It must be substantiated by applicable tests or shown by analysis that the physical properties of the tire materials have not been degraded by exposure of the tire to the temperature extremes of not higher than -40°F and not lower than +100°F for a period of not less than 24 hours at each extreme.

4.4.2 Wheel rim bead. It must be substantiated by the applicable tests or shown by analysis that the physical properties of the tire materials have not been degraded by exposure of the tire to a wheel bead set temperature of not lower than 300°F for at least 1 hour, except that low-speed tires or nose-wheel tires may be tested or analyzed at the highest wheel-bead seat temperature expected to be encountered during normal operations.

4.5 Tread design. Changes in materials that affect performance or changes in number or location of tread ribs and grooves or skid depth increases, made subsequent to the tire qualification, are major changes and must be substantiated by dynamometer tests in accordance with paragraph 6.0.

4.6 Slippage. Tires tested in accordance with the dynamometer tests provided by paragraph 6.0 may not slip on the wheel rim during the first five dynamometer cycles. Slippage that subsequently occurs may not damage the tube, valve, or the air seal of the tire bead of tubeless tires.

4.7 Leakage. After an initial 12-hour minimum stabilization period, the tire must be capable of retaining air pressure with a loss of pressure not exceeding 5 percent in 24 hours from the initial pressure equal to the rated inflation pressure.

5.0 Ratings.

5.1 Load ratings. The load ratings of aircraft tires must be established in accordance with the provisions under Sections 23.733, 25.733, 27,733, and 29.733 of this chapter, in effect on December 31, 1979, as appropriate.

5.2 Rated inflation pressure. The rated inflation pressure must be established at an

identified ambient temperature on the basis of the rated load as established under paragraph 5.1.

5.3 Loaded radius. The loaded radius is defined as the distance from the axle centerline to a flat surface for a tie initially inflated to the rated inflation pressure and then loaded to its rated load against the flat surface. The nominal loaded radius, the allowable tolerance on the loaded radius, and the actual loaded radius for the test tires must be identified.

6.0 Dynamometer test requirements. The tire may not fail the applicable dynamometer tests specified herein or have visible signs of deterioration other than normal expected tread wear except as provided in paragraph 6.3.3.3.

6.1 General. The following conditions apply to both low-speed and high-speed tires when these tires are subjected to the applicable dynamometer tests.

6.1.1 Tire test load. Unless otherwise specified herein for a particular test, the tire must be forced against the dynamometer flywheel at not less than the rated load of the tire during the entire roll distance of the test.

6.1.2 Test inflation pressure. The test inflation pressure must be the pressure required at an identified ambient temperature to obtain the same loaded radius against the flywheel of the dynamometer as the loaded radius for a flat surface as defined in paragraph 5.3 of this standard. Adjustments to the test inflation pressure may not be made to compensate for increases due to temperature rise occurring during the tests.

6.1.3 Test specimen. A single tire specimen must be used in the applicable dynamometer tests specified herein.

6.2 Low speed tires. Tires operating at ground speeds of 120 mph or less must withstand 200 landing cycles on a dynamometer at the following test temperature and kinetic energy and using either test method A or test method B.

6.2.1 Test temperature. The temperature of the air contained in the tire or of the carcass measured at the hottest point of the tire must be not lower than 105°F at the start of at least 90 percent of the test cycles. For the remaining 10 percent of the test cycles, the contained air or carcass temperature must be not lower than 80°F at the start of each cycle. Rolling the tire on the flywheel is acceptable for obtaining the minimum starting temperature.

6.2.2 Kinetic energy. The kinetic energy of the flywheel to be absorbed by the tire must be calculated as follows:

$K.E. = CWV^2 = 162.7W$ = Kinetic energy in foot pounds.

where

$C = 0.0113$,

W = Load rating of the tire in pounds,

$V = 120$ mph.

6.2.3 Test method A -- variable mass flywheel. The total number of dynamometer landings must be divided into two equal parts having speed ranges shown below. If the exact number of flywheel plates cannot be used to obtain the calculated kinetic energy value or proper flywheel width, a greater number of plates must be selected and the dynamometer speed adjusted to obtain the required kinetic energy.

6.2.3.1 Low-speed landings. In the first series of 100 landings, the maximum landing-speed is 90 mph and the minimum unlanding speed is 0 mph. The landing speed must be adjusted so that 58 percent of the kinetic energy calculated under paragraph 6.2.2 will be

absorbed by the tire. If the adjusted landing speed is calculated to be less than 80 mph, the following must be done: The landing speed must be determined by adding 28 percent of the kinetic energy calculated under paragraph 6.2.2 to the flywheel kinetic energy at 64 mph, and the unlanding speed determined by subtracting 28 percent of the kinetic energy calculated under paragraph 6.2.2 from the flywheel kinetic energy at 64 mph.

6.2.3.2 High-speed landings. In the second series of 100 landings, the minimum landing speed is 120 mph and the nominal unlanding speed is 90 mph. The unlanding speed must be adjusted as necessary so that 44 percent of the kinetic energy calculated under paragraph 6.2.2 will be absorbed by the tire.

6.2.4 Test method B -- fixed mass flywheel. The total number of dynamometer landings must be divided into two equal parts having speed ranges indicated below. Each landing must be made in a time period, T, calculated so that the tire will absorb the kinetic energy determined under paragraph 6.2.2. The time period must be calculated using the equation:

$$T_C = \frac{KE_C}{\left(\frac{KE_{W(UL)} - KE_{W(LL)}}{T_{L(UL)} - T_{L(LL)}}\right) - \left(\frac{KE_{W(UL)} - KE_{W(LL)}}{T_{W(UL)} - T_{W(LL)}}\right)}$$

For the, 90 mph to 0 mph test, the equation reduces to:

$$T_C = \frac{KE_C}{\left(\frac{KE_{W(UL)}}{T_{L(UL)}}\right) - \left(\frac{KE_{W(UL)}}{T_{W(UL)}}\right)}$$

where:

T_C = Calculated time, in seconds, for the tire to absorb the required kinetic energy.

KE_C = Kinetic energy, in foot pounds, the tire is required to absorb during each landing cycle.

KE_W = Kinetic energy, in foot pounds, of the flywheel at given speed.

T_L = Coast down time, in seconds, with rated tire load on flywheel.

T_W = Coast down time, in seconds, with no tire load on flywheel.

(UL) = Subscript for upper speed limit.

(LL) = Subscript for lower speed limit.

6.2.4.1 Low-speed loadings. In the first series of 100 landings, the tire must be landed against the flywheel with the flywheel having a peripheral speed of not less than 90 mph. The flywheel deceleration must be constant from 90 mph to 0 mph in the time T_C.

6.2.4.2 High-speed landings. In the second series of 100 landings, the tire must be landed against the flywheel with the flywheel having a peripheral speed of not less than 120 mph. The flywheel deceleration must be constant from 120 mph to 90 mph in the time T_C.

6.3 High-speed tires. Except as provided in the alternate test, tires operating at ground speeds greater than 120 mph must be tested on a dynamometer in accordance with paragraph 6.3.3. The curves to be used as a basis for tests under paragraph 6.3.3 must be established in accordance with the provisions of Sections 23.733 or 25.733, as appropriate. The load at the start of the test must be equal to the rated load of the tire. The load at any time during the test must be equal to the load shown on the established curve at the speed times the rated load of the tire divided by the initial load-speed-time curve

load of the tire. Alternate tests involving a landing sequence for tires operating at ground speeds greater than 120 mph and not over 160 mph are set forth in paragraph 6.3.4.
6.3.1 Test temperature. The temperature of the air contained in the tire or of the carcass measured at the hottest point of the tire must be not lower than 120°F at the start of at least 90 percent of the test cycles specified in paragraph 6.3.3.4 and at least 105°F at the start of the overload test (6.3.3.3) and of at least 90 percent of the test cycles specified in paragraphs 6.3.3.2 and 6.3.4. For the remaining 10 percent of each group of cycles, the contained air or carcass temperature must be not lower than 80° F at the start of each cycle. Rolling the tire on the dynamometer is acceptable for obtaining the minimum starting temperature.
6.3.2 Dynamometer test speeds. Applicable dynamometer test speeds for corresponding maximum ground speeds are as follows:

Medium ground speed of aircraft, mph		Speed rating of tire, mph	Minimum dynamometer speed at S_O, mph
Over	Not Over		
120	160	160	160
160	190	190	190
190	210	210	210
210	225	225	225
225	235	235	235
235	245	245	245

For ground speeds over 245 mph, the tire must be tested to the maximum applicable load-speed-time requirements and appropriately identified with the proper speed rating.
6.3.3 Dynamometer cycles. The test tire must withstand 50 takeoff cycles, 1 overload takeoff cycle, and 10 taxi cycles described below. The sequence of the cycles is optional.
6.3.3.1 Symbol definitions. The numerical values which are used for the following symbols must be determined from the applicable airplane load-speed-time data:
L_0 = Tire load at start of takeoff, pounds (not less than rated load).
L_1 = Tire load at rotation, pounds.
L_2 = Zero tire load (liftoff).
RD = Roll distance, feet.
S_0 = Zero tire speed.
S_1 = Tire speed at rotation, mph.
S_2 = Tire speed at liftoff, mph (not less than speed rating).
T_0 = Start of takeoff.
T_1 = Time to rotation, seconds.
T_2 = Time to liftoff, seconds.
6.3.3.2 Takeoff cycles. For these cycles the loads, speeds, and distance must conform to either Figure 1 or Figure 2. Figure 1 defines a test cycle that is generally applicable to any aircraft. If figure 2 is used to define the test cycle, the loads, speeds, and distance must be selected based on the most critical takeoff conditions established by the applicant.
6.3.3.3 Overload takeoff cycle. The cycle must duplicate the takeoff cycles specified

under paragraph 6.3.3.2 except that the tire load through the cycle must be increased by a factor of at least 1.5. Upon completion of the overload takeoff cycle, the tire must be capable of retaining air pressure with the loss of pressure not exceeding 10 percent in 24 hours from the initial test pressure. Good condition of the tire tread is not required.
6.3.3.4 Taxi cycles. The tire must withstand at least 10 taxi cycles on a dynamometer under the following test conditions:

Number of test cycles	Minimum tire load, lbs	Minimum speed mph	Minimum roll distance, ft.
8	Rated load	40	35,000
2	1.2 times rated load	to	35,000

6.3.4 Alternate dynamometer tests. For tires with a speed rating of 160 mph, test cycles which simulate landing may be used in lieu of the takeoff cycles specified in paragraphs 6.3.3.2 and 6.3.3.3. The tire must withstand 100 test cycles at rated load in accordance with paragraph 6.3.4.1 followed by 100 test cycles at rated load in accordance with paragraph 6.3.4.2.
6.3.4.1 Low-speed landings. In the first series of 100 landings, the test procedure for low-speed landings established under paragraphs 6.2.3 or 6.2.4, as appropriate, must be followed.
6.3.4.2 High-speed landings. In the second series of 100 landings, the test procedure for low-speed landings established under paragraphs 6.2.3 or 6.2.4, as appropriate, must be followed, except that the tire must be landed against the flywheel rotating at a speed of 160 mph with the rated load applied for the duration of the test. The unlanding speed must be adjusted as necessary in order that 44 percent of the kinetic energy, as calculated in paragraph 6.2.2, is absorbed by the tire during the series of tests.

FIGURE 1

GRAPHIC REPRESENTATION OF A UNIVERSAL LOAD-SPEED-TIME TEST CYCLE

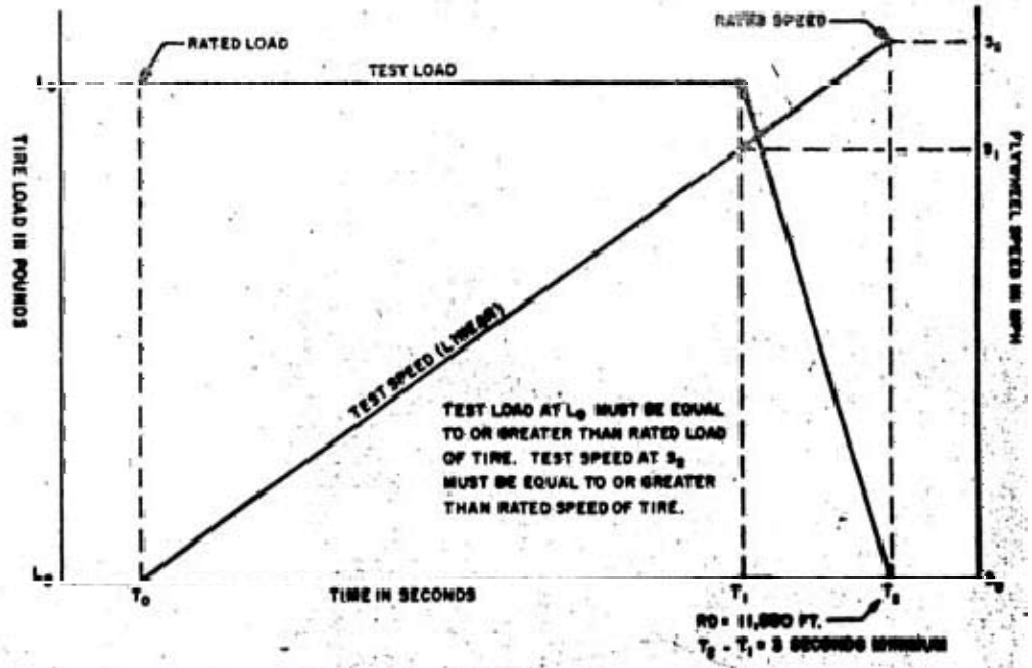
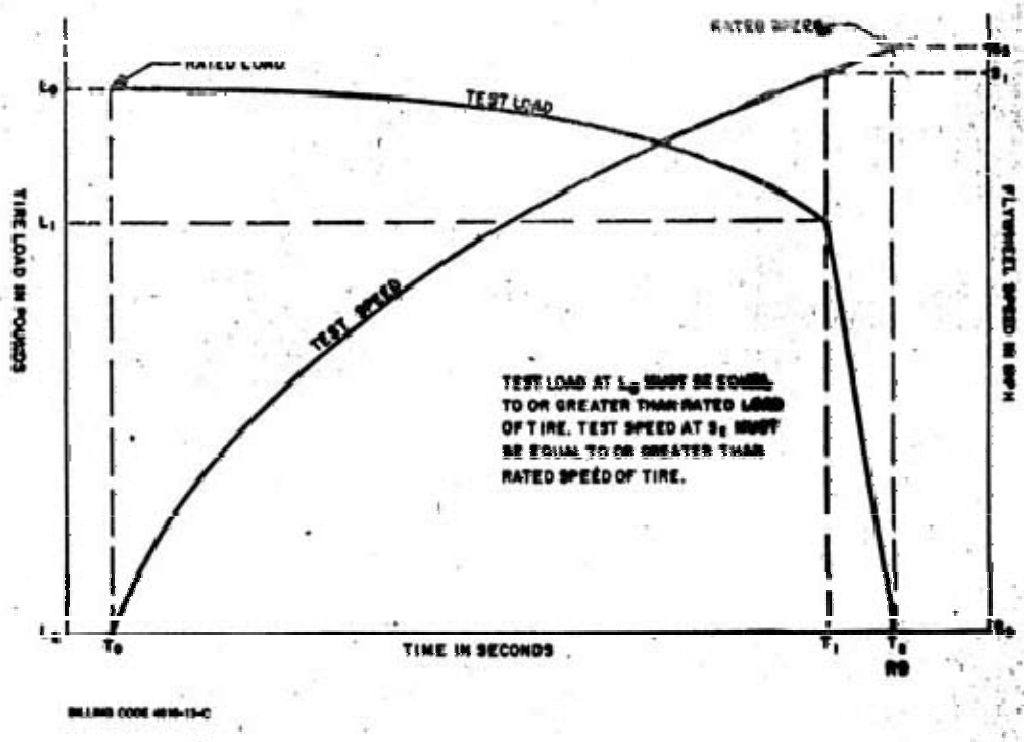


FIGURE 2

GRAPHIC REPRESENTATION OF A RATIONAL LOAD-SPEED-TIME TEST CYCLE



7.0 Requalification tests. Requalification in accordance with paragraph 6.0 of a given load rated tire required as a result of a tread design or material change will automatically qualify the same changes in a lesser load rated tire of the same size, speed rating, and skid depth provided--

7.1 The lesser load rated tire has been qualified to the applicable requirements specified in this standard; and

7.2 The ratio of qualifications testing load to rated load for the lesser load rated tire does not exceed the same ratio for the higher load rated tire at any given test condition.

(Secs. 313(a), 601 and 603, Federal Aviation Act of 1958, as amended (49 U.S.C. 1354(a), 1421 and 1423); sec. 6(c), Department of Transportation Act (49 U.S.C. 1655(c)).

NOTE: The FAA has determined that this document involves a regulation which is not considered to be significant under the procedures and criteria prescribed by Executive Order 12044 and as implemented by the Department of Transportation Regulatory

Policies and Procedures (44 FR 11034, February 26, 1979). A copy of the final evaluation prepared for this action is contained in the regulatory docket. A copy of the final evaluation prepared for this action is contained in the regulatory docket. A copy of it may be obtained by contacting the person identified under the caption "For Further Information Contact".

Footer Information

Issued in Washington, D.C., on November 21, 1979.
Langhorne Bond,
Administrator,
[FR Doc. 79-36044 Filed 11-28-79;8:45 am]
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Comments

Document History

Notice of Proposed Rulemaking Actions:
Notice of Proposed Rulemaking. Notice No. 79-7; Issued on 03/09/79.